SOME PRELIMINARY MODEL RESULTS OF LONGWAVE ANISOTROPY FROM CERES TRMM AND TERRA

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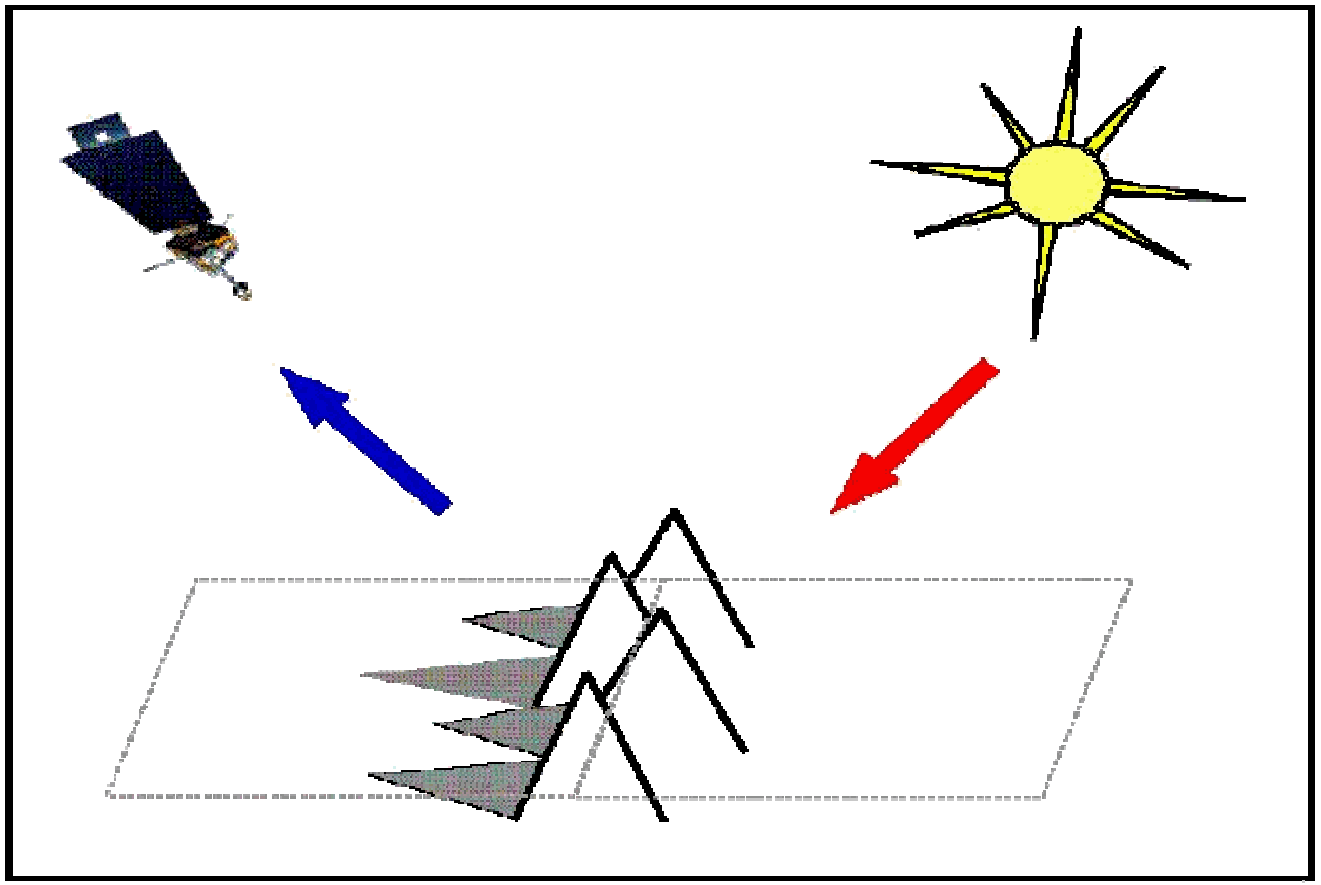
THEME OF STUDY



Forward scatter
Colder temperature measured

Back scatter
Warmer temperature measured

Notice that the unlit side can be cooler because of shadowing.

DATA & AVERAGING

CERES RAPS SSF: **TOTAL - 5-100 μm** & **WN - 8-12 μm**

TRMM : JAN-AUG 1998 (At Nadir 10 km resolution)

TERRA: NOV-DEC 2000 & APR- MAY 2001 (20 km resolution)

Bin averaging criteria

9 RAA intervals (every 20°) **7 VZA** intervals (every 10°)

4 Cloud amounts:

1 - Clear (0-5%) **2** - Partly cloudy (5-50%)
3 - Mostly cloudy (50-95%) **4** -overcast (95-100%)

4 Local time bins solar day divided into 4 equal parts:

1- Early morning **2**-Late morning

3-Early afternoon **4**-Late afternoon

**Only late morning available for Terra data!*

Topographical (topo) data

ETOP05 5’ resolution (~10 km) elevation database

Surface topo Variability (SV) = SD 3x3 adjacent elevations

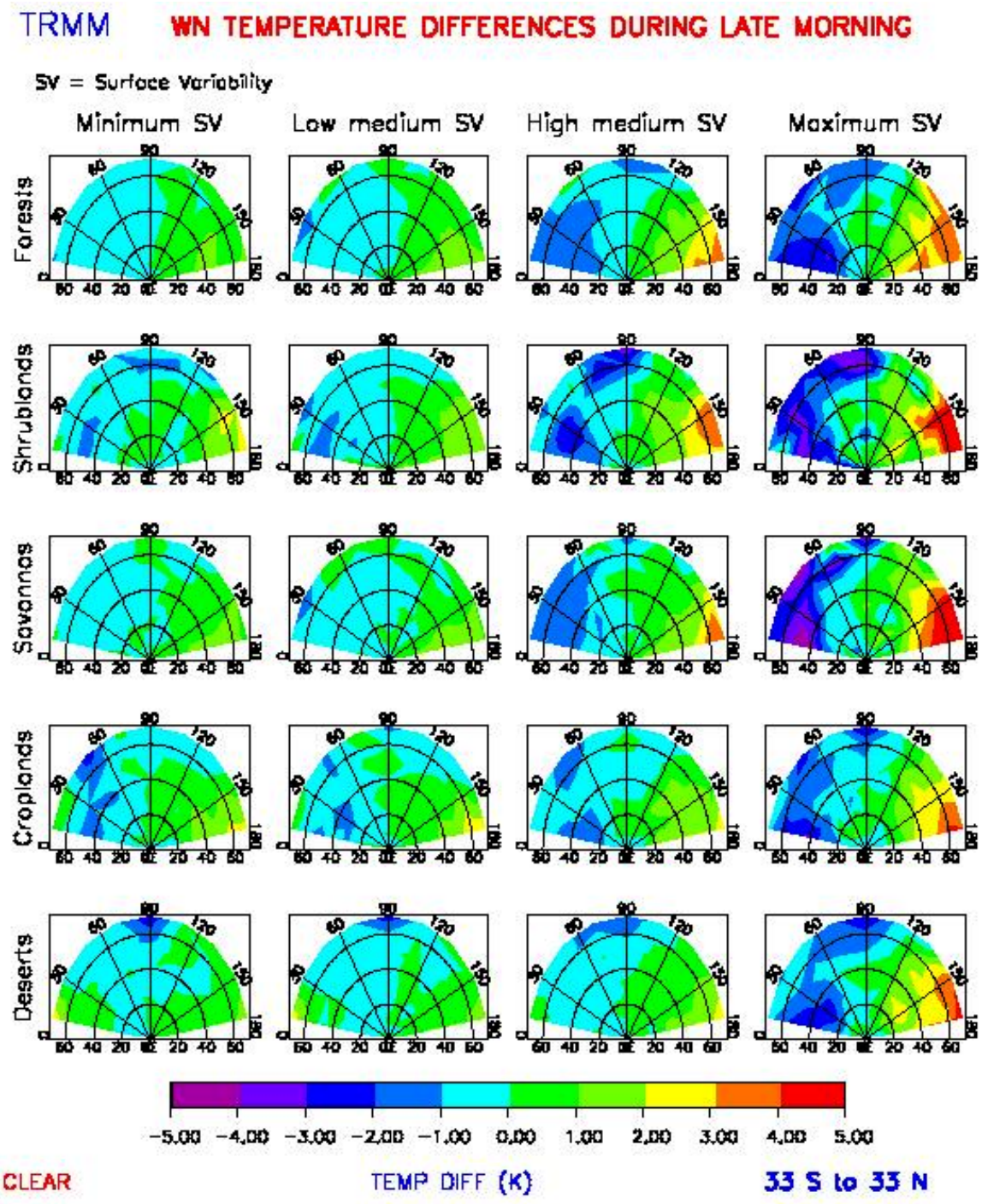
Made **4 bins** using histogram of global SV data:

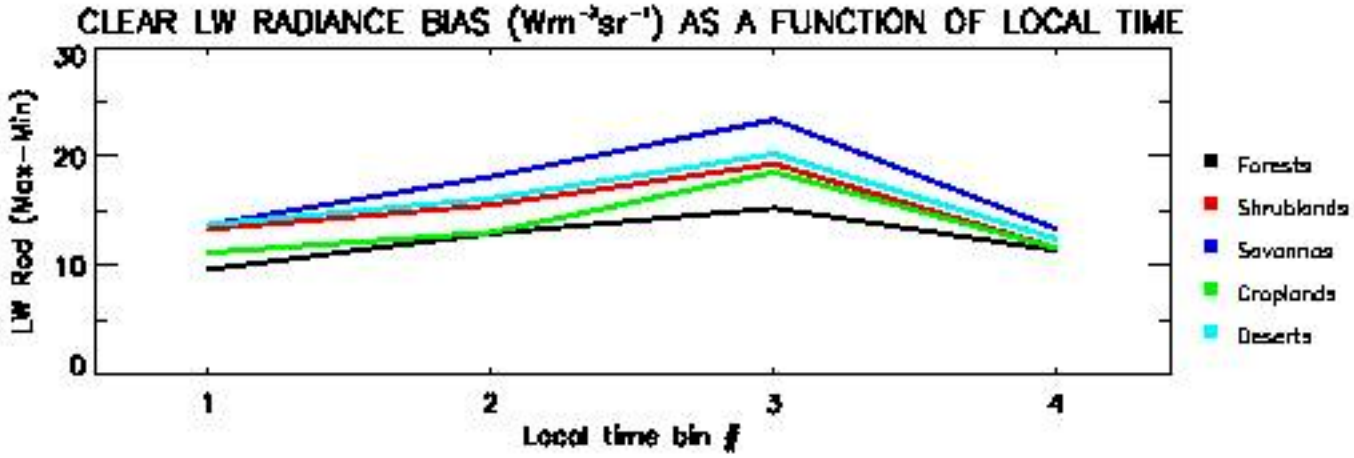
1 - Minimum SV (lowest 60%) **2** - Low-medium SV (60-80%)

3 - High-medium SV (80-90%) **4** - Maximum SV (90-100%)

Geotype: **5 scene types** redefined using IGBP classifications

Forests, Shrublands, Savannas, Croplands, and Deserts


TRMM
WN TEMPERATURE DIFFERENCES DURING LATE MORNING
SV = Surface Variability
Minimum SV
Low medium SV
High medium SV
Maximum SV
Forests
Shrublands
Savannas
Croplands
Deserts
-5.00 -4.00 -3.00 -2.00 -1.00 0.00 1.00 2.00 3.00 4.00 5.00
CLEAR
TEMP DIFF (K)
33 S to 33 N


CLEAR LW RADIANCE BIAS (Wm⁻²sr⁻¹) AS A FUNCTION OF LOCAL TIME
LW Rad (Max−Min)
30
20
10
0
1
2
3
4
Local time bin #
Forests
Shrublands
Savannas
Croplands
Deserts

SOME REMARKS

• Generally, **more** thermal radiation is observed in **backscatter** than in forward scatter directions

• Range in equivalent temperature differences between forward and backscatter for **WN** are **more than double** that for LW.

- Less atmospheric contribution in WN radiance

• In clear conditions, the greatest RAA & VZA anisotropy occurs **near noon**

• Azimuthal dependence of radiance appears to be **stronger function** of **topographical** variability than vegetation type.

- RAA variation greatest for shrublands and savannas

• RAA variation over **deserts** less consistent than over other types

• Observed LW radiances can be biased by 10-20 $Wm^{-2}sr$ and WN temperatures can be biased by 10-20 K

• Azimuthal dependence is also seen for partly & mostly cloudy conditions

- Insignificant variability for **overcast and ocean**

• Angular anisotropy from **TERRA** data **less** than for TRMM

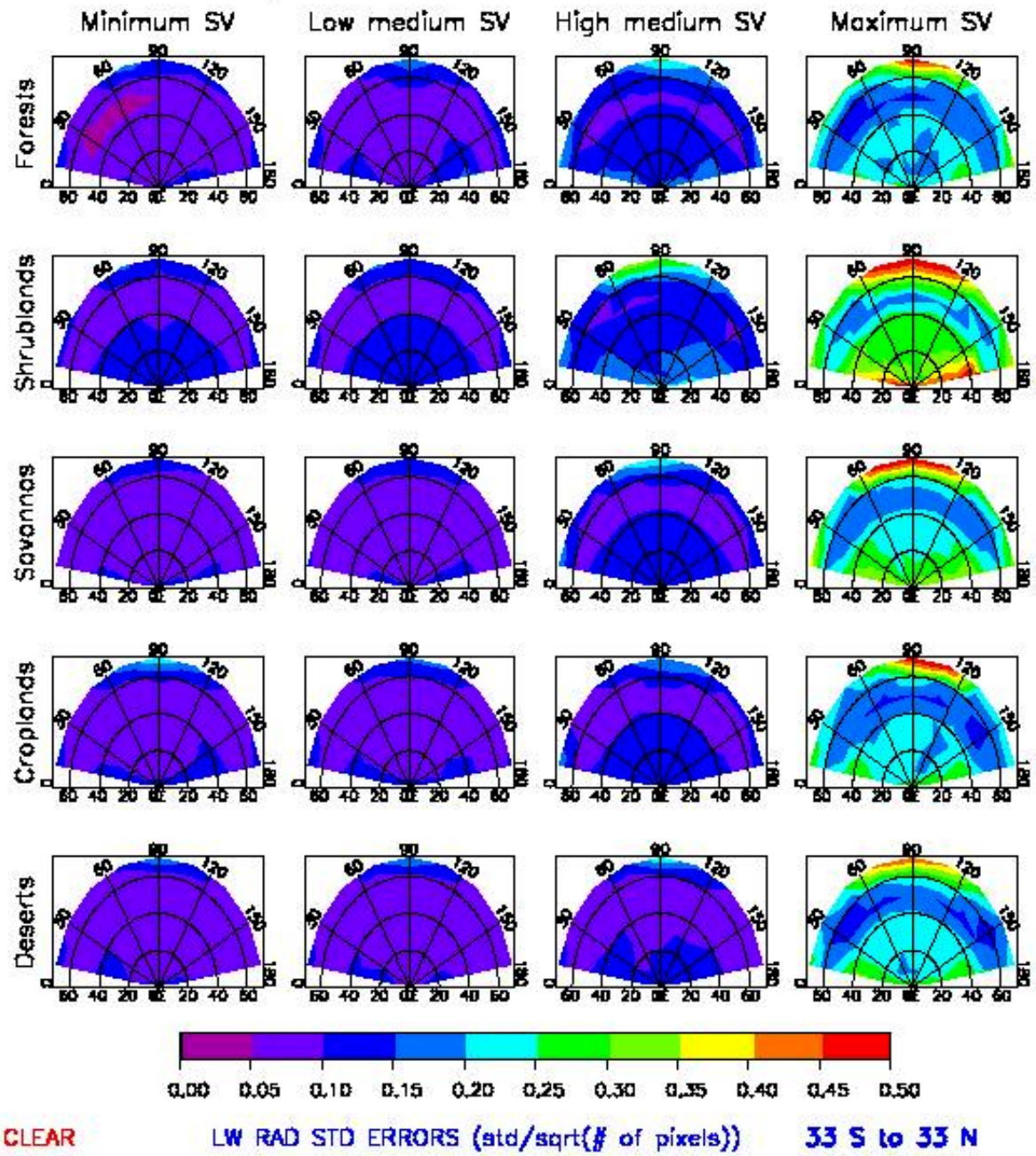
- orbital geometry differences, inclusion of mid & high latitudes

• Construction of correction models underway

- Concerns: sampling, length of day

TRMM **LW RADIANCE STD ERRORS DURING EARLY MORNING**

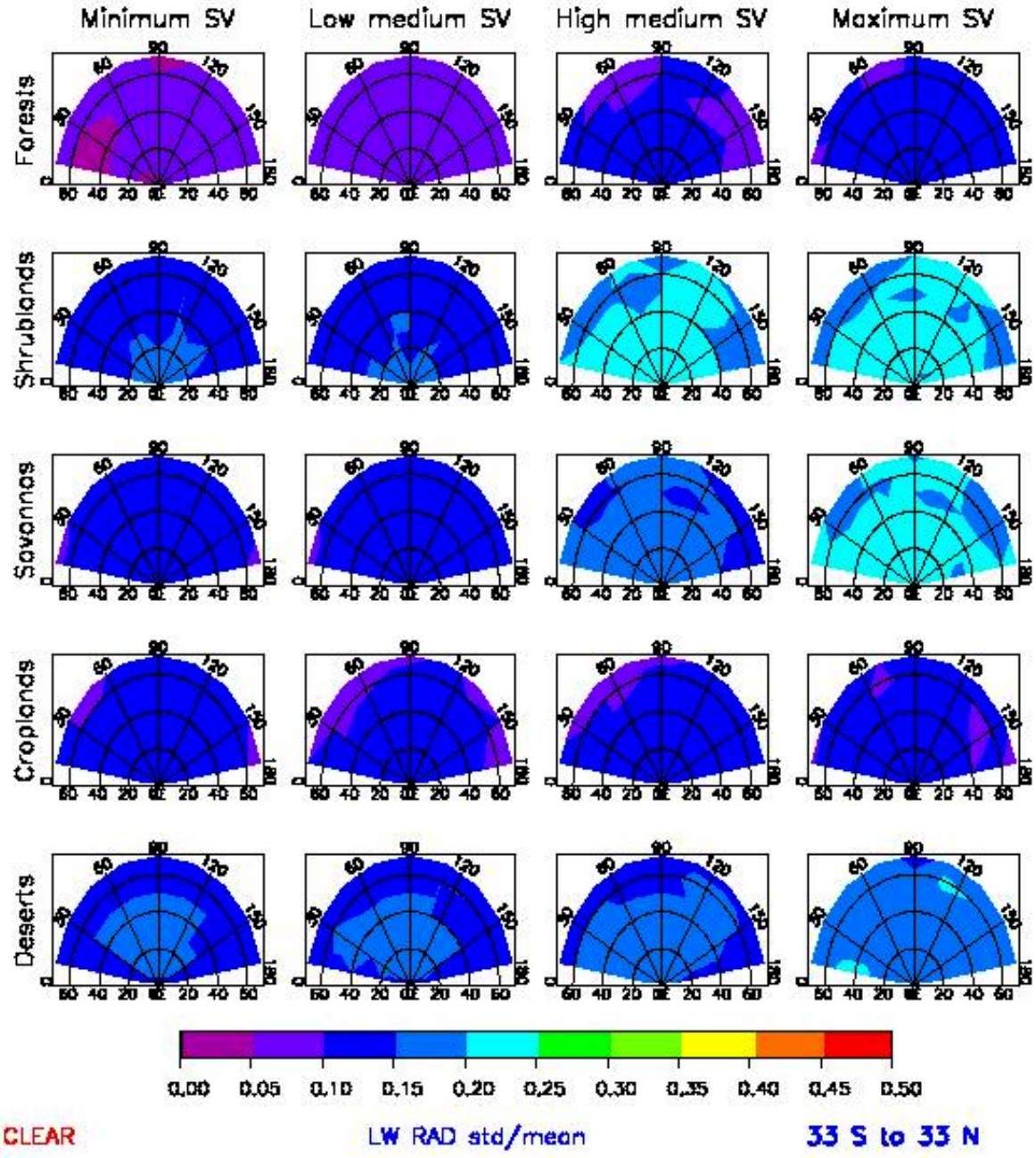
SV = Surface Variability



CLEAR LW RAD STD ERRORS (std/sqrt(# of pixels)) 33 S to 33 N

TRMM **LW RADIANCE STD plots DURING EARLY MORNING**

SV = Surface Variability



CLEAR

33 S to 33 N

MODEL

Use of Bilinear Interpolation

R (Anisotropic Factor) = Pi*L / M where

L = Radiance (Watts / m^2 / sr)

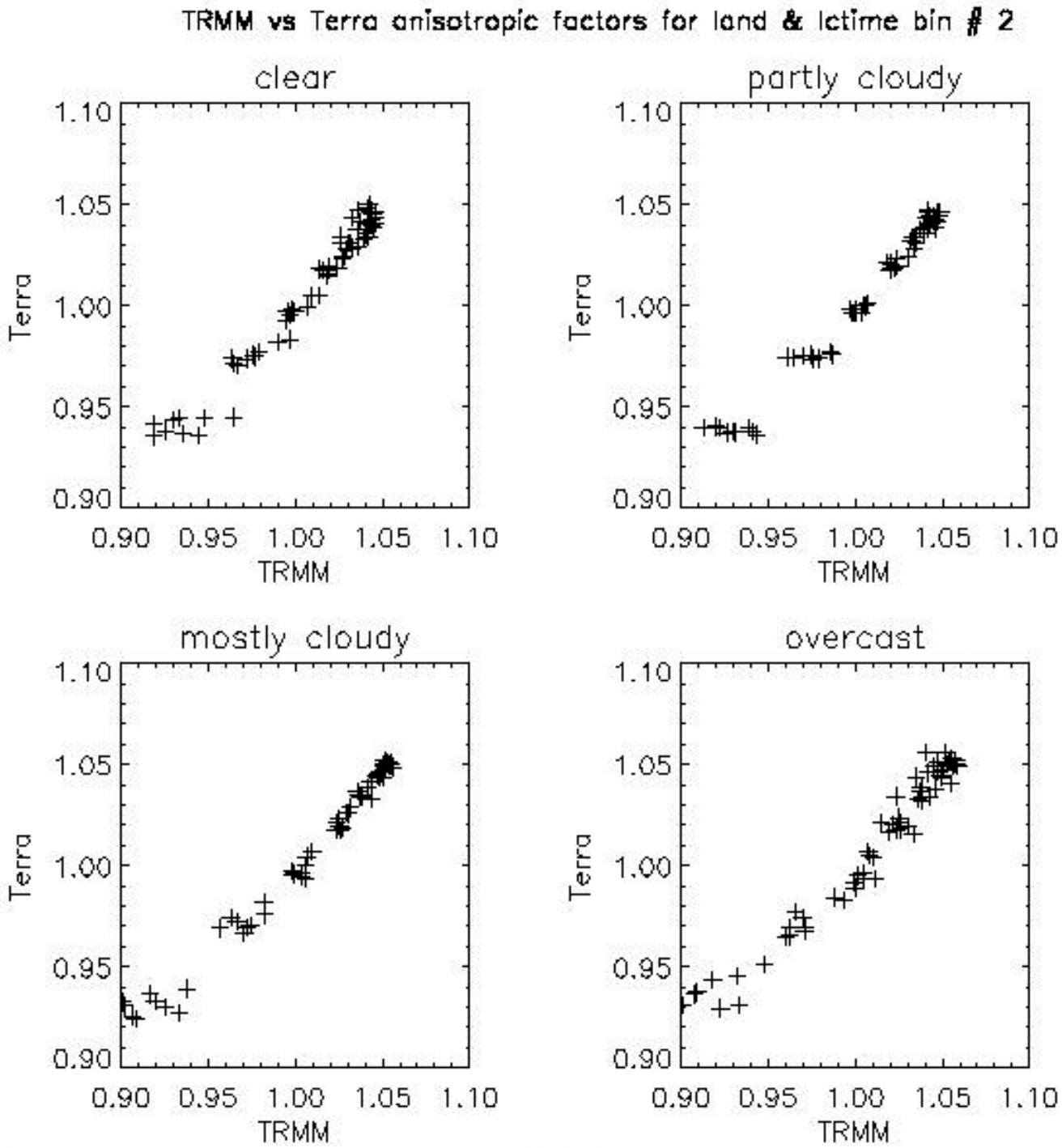
M = Flux (Watts / m^2)

Since VZA for CERES SSF data range 0-70^0

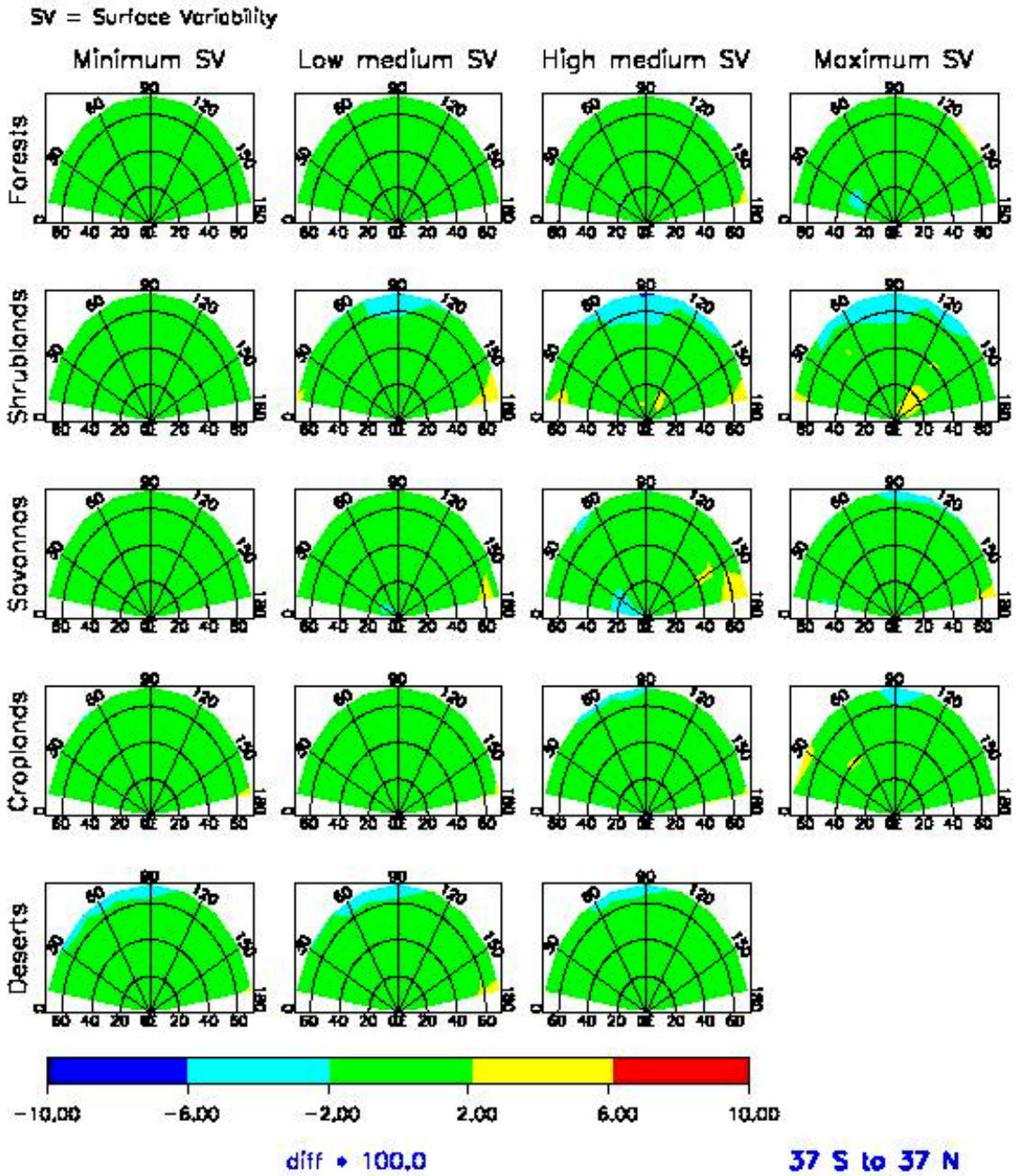
Pi is replaced by 2.7714

INPUT TO MODEL:

Latitude, Longitude, VZA, RAZ, LCT (Hrs), Cloudiness fraction


TRMM vs Terra anisotropic factors for land & lctime bin # 2
clear
partly cloudy
mostly cloudy
overcast
Terra
TRMM
1.10
1.05
1.00
0.95
0.90

DIFFERENCE BETWEEN ANISO FACTORS FROM TRMM AND TERRA FOR CLEAR SKY



The **model** is applied to 329 1^0 - boxes in South America region (between 0 -15^0 S and 45^0 W to 75^0 W) which are matched within 15´ for VIRS and GGEOS.

For these boxes, at first only limb darkening model & then our azimuthal model is applied.

GGOES assumed true. Departures -> limb & azim.

For points which our model is doing better,

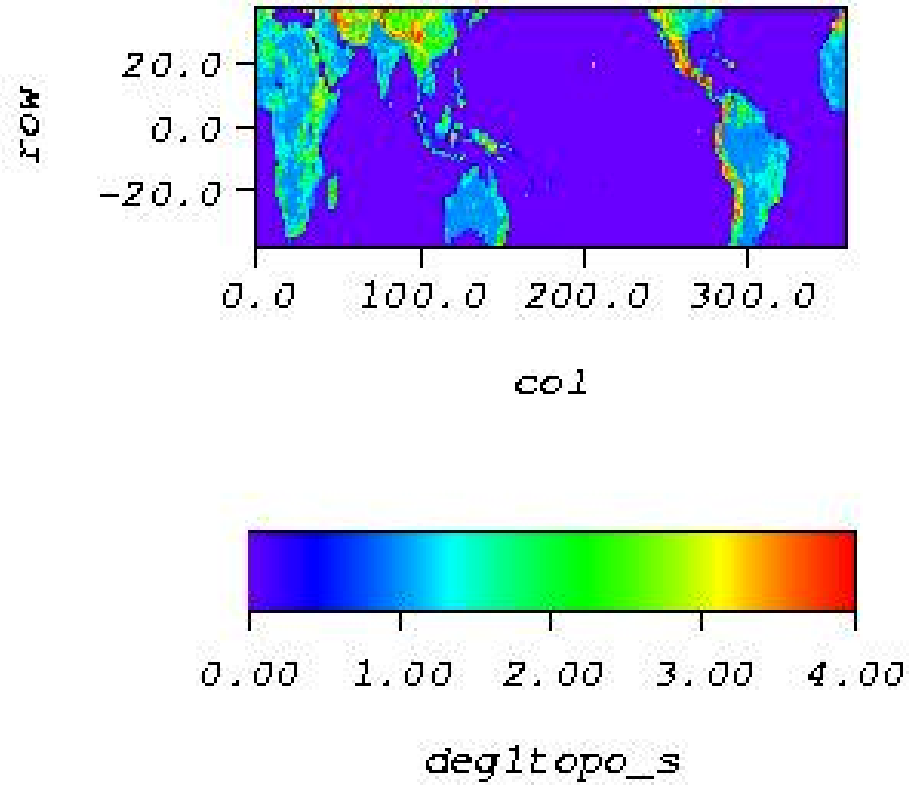
P1%= ((limb-azim) / (GGEOS-VIRS)) * 100.0

N(P1) -> 0-25%, 25-50%, 50-75% and 75-100%.

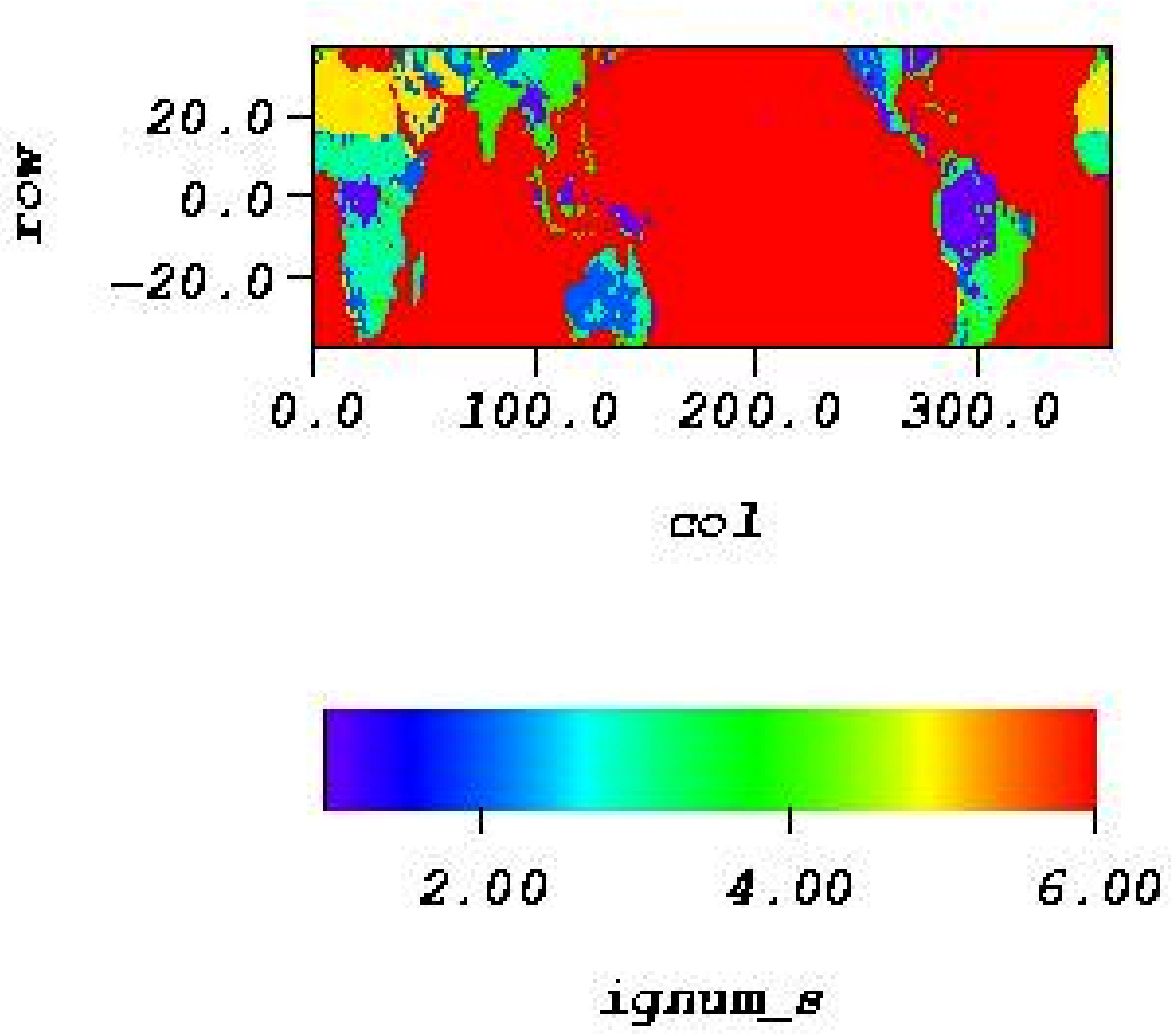
Repeated for boxes -limb is doing better S1%.

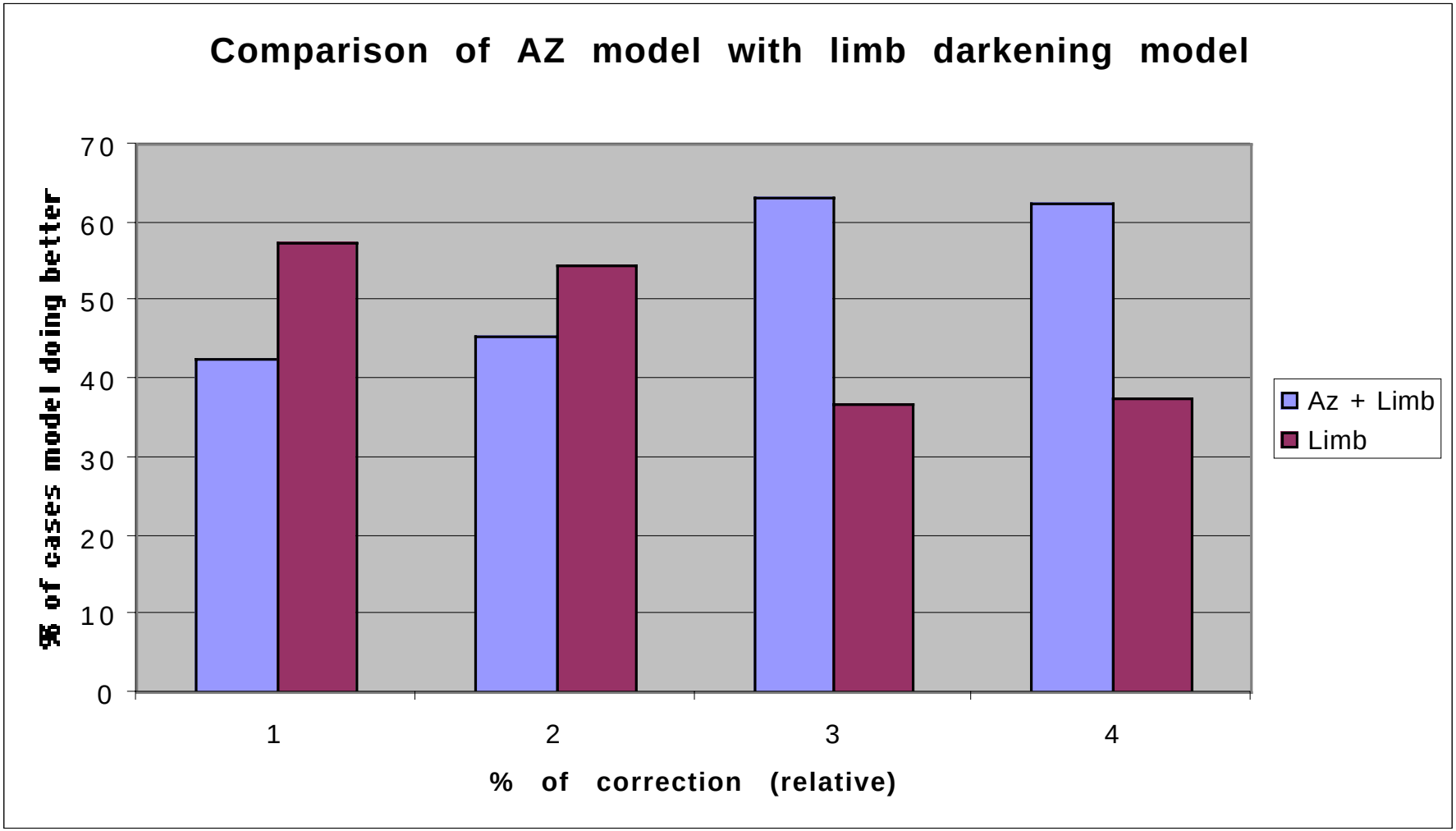
N(P1) and N(S1) are expressed as % and plotted

1 degree averaged topography



1 degree averaged IGBP scene




Comparison of AZ model with limb darkening model
% of cases model doing better
70
60
50
40
30
20
10
0
1
2
3
4
% of correction (relative)
Az + Limb
Limb

Conclusion

For cases of interest, incorporation of azimuthal corrections give better results when errors from assumed true values (GGEO) are more than 50% of maximum error.

Future -

Inclusion of solar zenith angle.

Testing for global data set for several months.